4.6 GEOLOGY AND SOILS

The geology and soil resource impact analysis consists of an evaluation of the potential effects generated by the construction and operation of the proposed project on specific geologic and soil resource attributes. Construction activities represent the principal means by which an effect to geologic resources (for example, limiting access to mineral or energy resources) and soil resources would occur. The principal element in assessing the effect on the geologic and soil resources is the amount and location of land disturbed during construction of the alternative, including proposed access roads, tower sites and construction areas, and project staging areas. The slope, depth below the ground surface to bedrock, and attributes of the soil within each corridor are evaluated to assess the potential construction techniques and the associated degree of land disturbance.

Methodology

Aerial and ground surveys of representative sections of each corridor were conducted to observe surficial soil and rock conditions (Terracon 2002). To determine if an action may cause a significant impact, both the context of the action and the intensity of the impact are considered. For actions such as those proposed in this document, the context is the locally affected area and significance depends on the effects in the local area. The intensity of the impact is primarily considered in terms of the relative land area disturbance based on the required construction technique, and on any unique characteristics of the area (for example, mineral resources), and the degree to which the proposed project may adversely affect such unique resources.

Geology. Impact analysis on the geologic resource by the proposed project involves the evaluation of potential effects to critical geologic attributes such as access to mineral and energy resources, destruction of unique geologic features, vibratory ground motion induced by seismic activity, subsidence induced by groundwater withdrawal, and mass movement or ground shifting induced by the construction of facilities associated with an alternative. The impact analysis includes the analysis of large-scale geological conditions such as earthquakes, volcanism, and geological resources. These conditions tend to effect broad expanses of land and typically are not restricted to smaller discrete areas of land.

Soil. Impact analysis on the soil resource by the proposed project involves the evaluation of potential effects to specific soil attributes, such as increasing the potential for erosion and compaction by construction activities. Unlike the large scale geologic conditions discussed above, effects to the soil resource occur on discrete areas of land. Surface erosion is most prevalent in areas where a highly erodible material is exposed to concentrated surface runoff.

4.6.1 Geology

4.6.1.1 *Western Corridor*

The placement of the transmission line structures and access roads would require some disturbance and removal of near-surface material, as described in Section 3.6, Geology and Soils. In siting the proposed access roads and tower locations, Tucson Electric Power Company's (TEP's) preliminary design of the project avoids prominent topographic features (such as the Castle Rock outcrop south of Peña Blanca Lake, located as shown in Figure 3.2–2). Avoiding such prominent topographic features prevents scarring of the land, and contributes to mitigation of potential visual impacts (see Section 4.2, Visual Impacts).

Because of the low relief (relatively flat landform) of most of the northern portion of the Western Corridor, the potential for slope failure would be insignificant. However, in the mountainous areas in the southern portion of the corridor (primarily in the Coronado National Forest), as discussed in Section

3.6.1, Geology, there is potential for ground failure (for example, a landslide) where the corridor crosses steep mountain ridges. Relatively intact bedrock, which is not subject to ground failure, is near to or exposed at the ground surface along the majority of the Western Corridor on the west side of the Tumacacori Mountains. These conditions should be suitable for supporting poles on a rock bolted base, in which small holes (less than 6 in [15 cm] in diameter) are drilled into the bedrock and the tower is attached with large bolts. To ensure structure stability, TEP would conduct detailed geotechnical studies at the potential locations for tower structures to determine the suitability of specific areas, once a corridor has been selected. The Western Corridor would cross limited areas where significant soil horizons would be encountered, which would require direct embedment poles. This type of pole installation requires excavation of a shaft wider than the pole using a caisson-drilling rig, and then subsequent backfilling around the pole. In soils with large cobbles (rocks) or soils that tend to collapse, a large pit is often excavated, in which the pole is placed. In such cases, a lean-concrete slurry may be required for backfill of the pit because soils with large cobbles are difficult to compact adequately (Terracon 2002). However, the total land area disturbed by either construction method is similar (an approximate 100-ft [30.5-m] radius).

Based on the Roads Analysis (URS 2003a) required by the U.S. Department of Agriculture Forest Service (USFS) for national forest land, the proposed roads that would be constructed by TEP for the Western Corridor would be on bedrock for approximately 53 percent of their length, and would be on unconsolidated alluvium (soil) for the remaining 47 percent of their length. Roads located on bedrock would be subject to neither erosion nor compaction and no impacts to the geologic environment would be expected. Potential impacts from roads constructed on unconsolidated alluvium are discussed in Section 4.6.2, Soils.

No sand or gravel mining occurs within the Western Corridor and no active surface mines are crossed. No impact to geologic resource availability would be expected from implementation of the proposed project.

The Western Corridor is located adjacent to inactive mine tailing areas west of Sahuarita (Township 17 South, Range 13 East). Since the proposed corridor alignments are within currently existing electric transmission corridor alignments in the vicinity of the mine tailing areas, it is not expected that the mine tailing areas would be expanded into these areas in the future. Therefore, no impact to the tailing areas would be expected from implementation of the proposed project.

Although seismic risk is low to moderate, given the seismic history of the area, locations of active faults and typical recurrence intervals discussed in Section 3.1, it is unlikely that the proposed project would be threatened significantly. However, design of the proposed project would take local seismic risk into consideration to mitigate any potential damage.

4.6.1.2 *Central Corridor*

The potential impacts described above for the Western Corridor would also generally apply to the Central Corridor.

Similar to the Western Corridor, because of the low relief (relatively flat landform) of most of the northern portion of the Central Corridor, the potential for slope failure would be insignificant. A majority of the Central Corridor near and on the Coronado National Forest (approximately 10 mi [16 km] on Quaternary alluvium, as shown in Figure 3.6–1) has exposed soil at the surface rather than bedrock. Foundations for structures along the Central Corridor in these areas would most likely require direct embedment poles. The unconsolidated gravelly and cobbly soils would make excavation of the embedment zone (hole) challenging, requiring excavation of a large pit. A lean-concrete slurry would likely be required for backfill of the pit because soils with large cobbles are difficult to compact adequately. Where the southern portion of the Central Corridor intersects areas of relatively intact bedrock, rock bolting would be appropriate (Terracon 2002). To ensure structure stability, TEP would conduct detailed geotechnical studies at the potential locations for tower structures to determine the suitability of specific areas, once a corridor has been selected.

Based on the Roads Analysis (URS 2003a) required by USFS for national forest land, the proposed roads that would be constructed by TEP for the Central Corridor would be on bedrock for approximately 15 percent of their length, and would be on unconsolidated alluvium (soil) for the remaining 85 percent of their length. Roads located on bedrock would be subject to neither erosion nor compaction and no impacts to the geologic environment would be expected. Potential impacts from roads constructed on unconsolidated alluvium are discussed in Section 4.6.2, Soils.

Similar to the Western Corridor, no impact to geologic resource availability or adjacent mine tailing areas west of Sahuarita would be expected from implementation of the Central Corridor. The design of the proposed project would take local seismic risk into consideration to mitigate any potential damage.

4.6.1.3 *Crossover Corridor*

The potential impacts described above for the Western Corridor would also generally apply to the Crossover Corridor.

In the vicinity of Peck Canyon and upon crossing other steep mountainous area, as discussed in Section 3.6.1, Geology, there is potential for ground failure in areas where bedrock is not exposed. Where the Crossover Corridor passes through Peck Canyon for approximately 7 mi (11 km), the majority of the land has bedrock exposed at the surface. It would be expected that these conditions would be suitable for supporting rock bolted poles (Terracon 2002). To ensure structure stability, TEP would conduct detailed geotechnical studies at the potential locations for tower structures to determine the suitability of specific areas, once a corridor has been selected.

Based on the Roads Analysis (URS 2003a) required by USFS for national forest land, the proposed roads that would be constructed by TEP for the Crossover Corridor would be on bedrock for approximately 53 percent of their length, and would be on unconsolidated alluvium (soil) for the remaining 47 percent of their length. Roads located on bedrock would be subject to neither erosion nor compaction and no impacts to the geologic environment would be expected. Potential impacts from roads constructed on unconsolidated alluvium are discussed in Section 4.6.2, Soils.

As for the Western Corridor, no impact to geologic resource availability or adjacent mine tailing areas west of Sahuarita would be expected from implementation of the Crossover Corridor. The design of the proposed project would take local seismic risk into consideration to mitigate any potential damage.

4.6.1.4 *No Action Alternative*

Under the No Action Alternative, TEP would not build the proposed transmission line and the associated facilities as proposed in this Environmental Impact Statement (EIS). Therefore, there would be no potential impact to geologic resources. Current geologic conditions as described in Section 3.6.1, Geology, would continue.

4.6.2 Soils

4.6.2.1 *Western Corridor*

The soils of the project area would be impacted in areas of proposed access roads, support structure sites, construction areas, and project staging areas, as described in Section 4.1, Land Use. No cultivated areas would be disturbed. The major impact would occur during construction. An increased potential for erosion and soil compaction would occur as large equipment, including heavy trucks and cranes as listed in Section 2.2, is used to install the transmission line. Clearing of the right-of-way (ROW), where necessary, would decrease vegetation cover and may increase erosional factors, while extended and continued use of large equipment may compact the soil. Compaction of the soil can lead to rutting of the road surfaces.

Based on the Roads Analysis (URS 2003a) required by USFS for national forest land, for the Western Corridor, the new temporary area of disturbance during construction would be approximately 197 acres (78.5 ha), and the new permanent area of disturbance would be approximately 29.3 acres (11.9 ha). Information regarding site-specific conditions where individual roads are planned would be used during design and construction of the new roads to calculate and minimize erosion. Only spot repairs would be necessary on existing Forest System roads, as shown in Figure 3.12–1. Repairs of existing roads would likely have a positive impact because the upgrades would reduce erosion potential. On new proposed access roads, these soils would be compacted from vehicles and erosion potential could increase over the non-developed condition. In areas where slopes are mild, soil erosion impacts are expected to be minor.

TEP is in consultation with USFS regarding development of BMPs for minimizing impacts (on geologic, soil, and water resources) from the proposed project, in accordance with the USFS “Soil and Water Conservation Practices Handbook” (USFS 1990). Specific BMPs would be identified after coordination with the Arizona Department of Environmental Quality (ADEQ) and before implementation of the project, for the entire length of the selected corridor. TEP’s ongoing consultation with land owners and managers includes parameters for new road construction (URS 2003a). These road parameters include issues such as sideslopes, grades, water bars and rolling dips (to divert water off the roads), width, and road closure. Erosion control measures included in the BMPs would also address areas where slopes are such that soil erosion is a potential concern, and areas where wind related erosion is a concern.

The Western Corridor would cross soils considered to be prime farmland when irrigated. Although the exact placement of the structures cannot be determined at this time, much of the potential prime farmland soils would be spanned by the power line, as opposed to being directly converted to land within the structures footprint. As shown on Table 4.1–1, the estimated total footprint of the structures for the Western Corridor is 0.25 acres (0.1 ha). Thus, the total acreage of prime farmland soils potentially affected by the structures is less than 0.25 acres (0.1 ha).

4.6.2.2 *Central Corridor*

The expected impacts to soil resources and erosion control mitigation for the Central Corridor would be similar to those discussed above for the Western Corridor. The Central Corridor would disturb an area cultivated as permanent pasture for an estimated 0.5 mi (0.8 km) near where it crosses Sopori Wash (see Figure 3.7–1). The primary difference from the Western Corridor would be in the area of land affected by construction and operation of the Central Corridor. For the Central Corridor on the Coronado National Forest, the new temporary area of disturbance during construction would be approximately 105 acres (42.5 ha), and the new permanent area of disturbance would be an estimated 23.1 acres (9.35 ha) (URS 2003a). Spot repairs of existing roads would likely have a positive impact, as erosion potential would be expected to decrease as a result of the upgrade. Specific BMPs would be identified after coordination with USFS and ADEQ, and before implementation of the project, for the entire length of the selected corridor.

The potential for impacts to prime farmland soils along the Central Corridor is the same as discussed in Section 4.6.2.1 for the Western Corridor. The estimated total footprint of the structures, as shown on Table 4.1–1, for the Central Corridor is 0.21 acres (0.08 ha). Thus, the total acreage of prime farmland soils potentially affected by the structures is less than 0.21 acres (0.08 ha).

4.6.2.3 *Crossover Corridor*

The expected impacts to soil resources and erosion control mitigation for the Crossover Corridor would be similar to those discussed above for the Western Corridor. No cultivated areas would be disturbed. The primary difference would be in the area of land affected by construction and operation of the Crossover Corridor. For the Crossover Corridor on the Coronado National Forest, the new temporary area of disturbance during construction would be an estimated 238.4 acres (96.5 ha), and the new permanent area of disturbance would be an estimated 36.4 acres (14.7 ha) (URS 2003a). Spot repairs of existing roads would likely have a positive impact, as erosion potential would be expected to decrease as a result of the upgrade. Specific BMPs would be identified after coordination with USFS and ADEQ, and before implementation of the project, for the entire length of the selected corridor.

The potential for impacts to prime farmland soils along the Crossover Corridor is the same as discussed in Section 4.6.2.1 for the Western Corridor. The estimated total footprint of the structures, as shown on Table 4.1–1, for the Crossover Corridor is 0.25 acres (0.1 ha). Thus, the total acreage of prime farmland soils potentially affected by the structures is less than 0.25 acres (0.1 ha).

4.6.2.4 *No Action Alternative*

Under the No Action Alternative, TEP would not build the proposed transmission line and associated facilities as proposed in this EIS. No cultivated areas or prime farmland soils would be disturbed and erosion and resultant sediment transport would continue naturally in undisturbed areas.